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THE NERNST FESTSCHRIFT.

Festschrift W. Nernst zu seinem fünfundzwanzigjärigen Doktorjubiläum gewidmet von seinen Schülern. Pp. vi+487. (Halle a.d.S.: Wilhelm Knapp, 1912.) Price 21.60 marks.

THE present volume of scientific papers, dedicated to Prof. W. Nernst by his present and past pupils on the twenty-fifth anniversary of his promotion to the doctorate, is a splendid tribute to the success of Nernst as a great investigator and creator of investigators. It contains forty-four papers dealing with physicochemical subjects, many of them of great interest and importance. Their great variety forms a striking testimony to the extraordinary range and scope of the investigations which Nernst himself has personally carried out or directed and supervised.

Nernst's laboratory at Göttingen first became famous as a centre of electrochemical research, whilst at the present day his laboratory in Berlin is known all the world over as the headquarters of chemical equilibrium and affinity, not to mention molecular and atomic dynamics. His investigations have carried him from the ion of Arrhenius to the energy-quantum of Planck. Everywhere throughout this brilliant career the investigations of Nernst have been of fundamental importance for the growth and development of chemical and physical science. The science of physical chemistry in particular has reaped a bountiful harvest. The physical chemists of the world, in common with many other men of science, will therefore join heartily with Nernst's own pupils in congratulating him on the splendid work he has done, and in wishing him many years yet of successful scientific productivity.

It would be quite impossible in the space at our disposal even to enumerate, much less to describe in detail, the papers published in the *Festschrift*. This will be apparent when one recollects that it runs to nearly 500 pages. It must suffice, therefore, to indicate the nature of a few of the most interesting.

E. Abel has investigated the equilibrium (iodine-hydrolysis) $3I_2+3H_2O \rightleftharpoons 6H^{\cdot}+5I + IO_3$ in the presence of sodium acetate. In combination with the work of Sammet, the results obtained by Abel form one of the most extensive and searching verifications of the law of chemical equilibrium in aqueous solutions.

E. D'Agostino and G. Quagliariello discuss mathematically the curve of $\text{Log}[H^{\cdot}]$ as a function of the number of mols. acid or base added to a solution of a base or acid respectively, or to a solution of an amphotere. They show both theoretically and by practical numerical examples how the molar concentration, molecular weight, and dissociation-constants of a solution of an unknown acid, base, or amphotere can be deduced from such curves. Their method promises to be of great importance in dealing with proteids.

P. Askenasy and A. Solberg discuss the thermal decomposition of potassium permanganate. F. Bergius contributes an interesting paper on the formation and dissociation of calcium superoxide. Max Bodenstein and F. Kranendieck conclude from an investigation on the velocity of decomposition of ammonia in quartz vessels that the decomposition occurs in the pores of the quartz glass and is regulated by the diffusion of the ammonia into these pores.

K. Bornemann finds for the reduction-potential of hydrogen peroxide in aqueous solution $\epsilon_h = -0{\cdot}66 \pm 0{\cdot}03$ volt, and for the oxidation-potential $\epsilon_h = -1{\cdot}80 \pm 0{\cdot}03$. Both potentials are referred to that of hydrogen in a solution of the same $H^{\cdot}$-concentration.

A. Coehn and G. Grote contribute a long and valuable paper on the action of ultra-violet light on aqueous vapour and on electrolytic gas (hydrogen + oxygen).

R. Höber describes a new method of determining the inner electrical conductivity of blood cells. J. R. Katz applies Nernst's equation for "ideally concentrated" solutions to the phenomena of *Quellung*. Wl. Kistiakowsky gives an interesting account of the effect of motion on electrode-potentials and the phenomena of periodic passivity. F. Krüger discusses the formation of ozone by the silent discharge. F. A. Lindemann, in a most interesting paper, investigates mathematically the forces acting between the atoms of solid bodies. R. Lorenz gives an account of the present position of the question as to the electrolytic dissociation of molten salts. L. Michaelis discusses the iso-electric point of the "electro-amphoteric" colloids. E. and D. Müller determine the velocity coefficient of chlorate formation by an electrolytic method. N. Parravano and G. Sirovich discuss generally the phenomena of crystallisation in ternary systems. H. Pick contributes some interesting results on the molecular state and ionisation of aqueous solutions of hydrofluoric acid. R. Ruer and E. Scharff have investigated the effect of light on an anodically charged platinum electrode. O. Sackur discusses from a mathematical point of view the relation of the energy-quantum to the kinetic theory of gases and the calculation of Nernst's chemical constants.

G. Tammann discusses the effect of temperature on crystalline form. H. v. Wartenberg con-

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tributes some interesting data on the thermochemistry of silicon. F. Weigert has an important paper on the effect of oxygen in retarding and inhibiting photochemical reactions. It will be evident from this very brief summary that the Nernst *Festschrift* is full of interesting material and is in every sense worthy of the distinguished physical chemist in whose honour it was published.

F. G. DONNAN.

FUNCTION THEORY.

Lectures on the Theory of Functions of Real Variables. Vol. ii. By Prof. J. Pierpoint. Pp. xiii+645. (Boston, New York, Chicago and London: Ginn and Co., 1912.) Price 20*s*. net.

THE main topics of this volume are proper and improper integrals, series and products, point-sets and aggregates, continuity and discontinuity, and the geometrical notions derived from intuition. In style and method it follows the same lines as vol. i.

The first thing to notice is the substitution of "metric set" instead of "measurable set" for a set of points the upper and lower contents of which are equal. In chapter xi. we have the theory of the upper and lower measure of any set which can be enclosed by a countable aggregate of metric sets. The treatment is quasi-geometrical, after the manner of Minkowski, but, of course, all the arguments used are purely arithmetical. In this, as in all other parts of the subject, we are struck by the variety of cases presented by the strict arithmetical theory, where intuition suggests one definite conclusion. There are so many new symbols used that it is difficult to give an account of this valuable and original discussion of measure; it concludes with a theorem which may be regarded as an extension of the statement that, if a finite segment is divided into any finite number of parts, the length of the segment is the sum of the lengths of the parts. It is extremely interesting to compare the analytical theorem, and those which lead up to it, with the geometrical theorem, taken as obvious by all previous generations of mathematicians.

Another novel feature of the work is the author's definition of improper integrals. This is given on p. 32, after a statement of two other current definitions. It leads (pp. 402 *sqq.*) to a discussion of improper Lebesgue integrals, and an extended theory of the change of order of integration in a multiple integral. The theory of Fourier series is discussed from the same point of view, and we are thus led to see that the Fourier expansions are valid for cases which do not satisfy the conditions of Riemann and Dirichlet. Lebesgue, in fact, has made an addition to the theory of trigonometrical series so great that it ought not to be ignored in any treatise dealing with them with any attempt at completeness.

The sections which deal with geometrical conceptions are those which are likely to have the greatest educational effect upon the mathematical student. If we define an analytical curve by the equations $x=\phi(t)$, $y=\psi(t)$, where $\phi(t)$, $\psi(t)$ are one-valued continuous functions of a real variable t in a certain interval, then the curve is continuous, and, if closed, bounds a region in the plane (x, y). But it need not have a tangent at every, or any, point: it may fill up a plane area, such as a square, and no arc of it need have a finite length. Anything more remote from the conclusions of ordinary intuition it is hard to conceive. At the same time, all these statements have been proved with the utmost degree of rigour at present attainable, and seem to be proof against all possible objections.

In a similar way, the definition of the area of a surface as the limit of that of an inscribed polyhedron was shown to be fallacious by Schwarz (whose proof is reproduced on p. 626). The author gives a definition of the area, based upon the assumption $x, y, z=\phi(u, v), \psi(u, v), \chi(u, v)$, where ϕ, ψ, χ are functions of the independent real variables u, v, which range over a certain field. Thus we are brought back once more to Gauss's classical memoir as the first analytical treatment of surfaces destined to be of permanent value in the widest sense.

Practically, a good deal of the success of a mathematical treatise depends upon its symbolism. Dr. Pierpoint seems to have fairly hit the mark; his new symbols are not too many to remember, and each of them crystallises an important conception. Undoubtedly we shall have, before very long, a new and generally accepted system of symbols. At present we are in a state of comparative chaos, just as at the time of the invention of the infinitesimal calculus. The sooner this is ended the better; and it might be appropriately discussed by the next mathematical congress, if there is any prospect of agreement.

An Englishman naturally compares this work with that of Dr. Hobson. Dr. Pierpoint has the advantage of writing at a later date, and is thus able to include more recent discoveries; in other respects there is a contrast, which does not detract from the merits of either work, but is more or less typical of the nationalities of their authors. One abbreviates when he can, the other when he feels that he must; one tries to avoid metaphysics, but scarcely succeeds, while the other

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